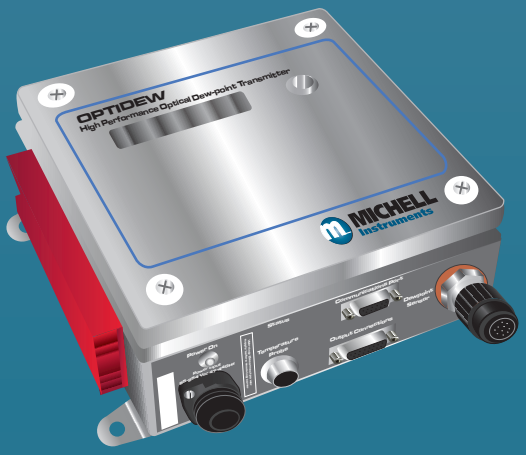
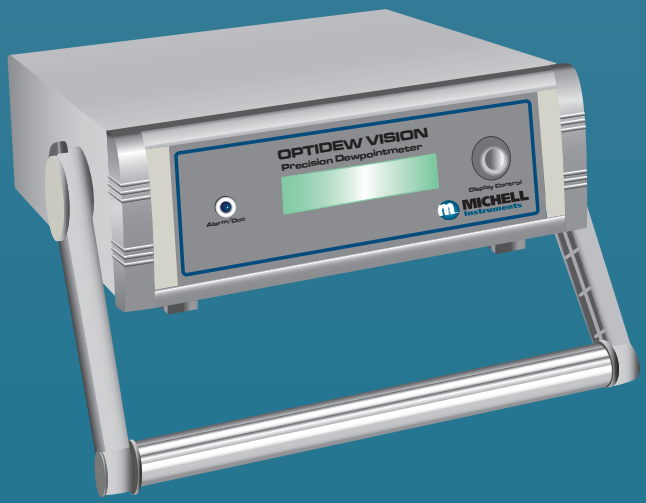
MICHELL Instruments

Optidew & Optidew Vision High Performance Optical Dew-Point Transmitter User's Manual





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Optidew & Optidew Vision

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Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to ensure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use qualified personnel and good engineering practice for all procedures in this manual.

Electrical Safety

The instrument is designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument.

Pressure Safety

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified safe working pressure is 20 barg (300 psig). The pressure rated versions can withstand 250 barg (3600 psig).

Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. Refer to www.michell.com for details of Michell Instruments' worldwide offices contact information.

Calibration

The recommended calibration interval for the Optidew Series is one year, unless otherwise specified by Michell Instruments. The instrument should be returned to the manufacturer, Michell Instruments, or one of their accredited service agents for re-calibration. Refer to www.michell.com for details of Michell Instruments' worldwide offices contact information.

Safety Conformity

This product meets the essential protection requirements of the relevant EU directives.

Abbreviations

The following abbreviations are used in this manual:

AC	alternating current
a_w	water activity - relative humidity on a scale of 0-1 with no units
atm	pressure unit (atmosphere)
barg	pressure unit (=100 kP or 0.987 atm) gauge
ºC	degrees Celsius
ºF	degrees Fahrenheit
Δ (t – t_{dp})	difference in ºC between ambient and dew-point temperature
DC	direct current
FAST	Frost Assurance System Technology
ft	feet
gm^{-3}	grams per cubic meter
gkg^{-1}	grams per kilogram
IEC	International Electrotechnical Commission
LED	Light Emitting Diode
m	meter(s)
mA	milliampere
Max	maximum
Min	minimum
mm	millimeters
m/sec	meters per second
N/C	not connected / normally closed relay contacts
N/O	normally open relay contacts
Nl/min	liters per minute
%	percentage
psig	pounds per square inch gauge
scfh	standard cubic feet per hour
RS232	serial data transmission standard
RS485	serial data transmission standard
T	temperature
V	Volts
W	Watts
Ω	Ohms

Warnings

The following general warnings listed below are applicable to this instrument. They are repeated in the text in the appropriate locations.

Where this hazard warning symbol appears in the following sections, it is used to indicate areas where potentially hazardous operations need to be carried out.

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1 INTRODUCTION

The Optidew Series precision hygrometers are based on the proven, fundamental optical dew-point measurement principle, giving long-term unmatched drift-free performance.

They offer a wide measurement range with a variety of sensor options to accommodate almost any application.

Data Communication and Application Software

The Optidew Series provides two linear 4-20 mA outputs, and RS232 or RS485 serial communications, allowing configuration and monitoring by a suitable computer, data logger or other device. An adjustable volt-free contact alarm means that the Optidew Series can be used for direct process control. The comprehensive application software provides an interface to configure and control instrument functions, and enables all measured and calculated parameters to be graphed or logged over time.

As a Calibration Reference

The Optidew Series make excellent entry level calibration references, supplied as standard with a fully traceable in-house calibration or optional UKAS-certified calibration. Their simple operation makes it possible for anyone to use with minimum training. Simply connect the instrument, power it up and measurement will begin automatically.

Frost Assurance Technology (FAST)

Super-cooled water can exist at temperatures down to -30°C (-22°F), and when formed on the mirror of a chilled mirror hygrometer can introduce errors of up to 10% in reading. All Michell chilled mirror products feature FAST, the frost assurance technology that guarantees all dew-point measurements below 0°C (+32°F) are made over ice. The FAST system works by rapidly cooling the mirror until a film of ice has formed on the mirror of pre-determined thickness – once ice has been formed, control returns to the instrument and measurement can begin.

Compact and Convenient Package

The bench-top enclosure for the Optidew Vision has a handle that doubles as a stand. An optional panel-mounting kit is also available for 19" rack mounting.

A bright and clear 2-line vacuum fluorescent display on the front panel enables the instrument parameters to be monitored even when not connected to the application software.

1.1 Optidew Series

The Optidew Series is available in two variants, which differ only in enclosure type, connectors and sensor cable:

Figure 1 *Optidew*

Figure 2 *Optidew Vision*

The Optidew features a rugged 304 stainless steel industrial enclosure, offering protection to IP66 / NEMA 4x. The enclosure is suitable for wall mounting, and can be ordered either as a blind transmitter or with an optional display.

The Optidew Vision is a bench top model, with integrated display, ideal for laboratory use.

1.2 Optidew Sensor

Optidew Series' sensors are available with either single stage, or dual stage peltier devices, and with a variety of different sensor body and mirror materials. The following tables show the capabilities of each sensor type:

	Single Stage	Dual Stage	Dual Stage Metal Body
Available sensor body materials	Acetal	Acetal PEEK	Aluminum Stainless steel
Approximate maximum depression	55°C (67°F)	65°C (85°F)	45°C (49°F)
Equivalent % RH range	2 to 100%	0.5 to 100%	4 to 100%
Lowest Measureable Dew Point			
Sensor temperature 20°C (68°F)	-30°C (-22°F)	-40°C (-40°F)	-20°C
With additional cooling	-40°C (-40°F)	-50°C (-58°F)	N/A

Table 1 Sensor Capabilities

	Acetal	PEEK Stainless Steel Aluminum
Maximum Temperature	+90°C (+194°F)	+130°C (+266°F)

Table 2 Sensor Body Materials

All sensor variants are available in high pressure versions, able to operate in pressure up to 250 barg (3600 psig).

2 INSTALLATION

2.1 Mounting

Optidew

The Optidew can be wall mounted using the four drilled tabs on each corner. It is possible to install the Optidew outside, providing it is shielded from direct sunlight and the climate is within the environmental requirements listed in Appendix A, Technical Specifications.

An optional weatherproof connector kit is available for the analog and digital outputs (Michell order code: OPT-WPS).

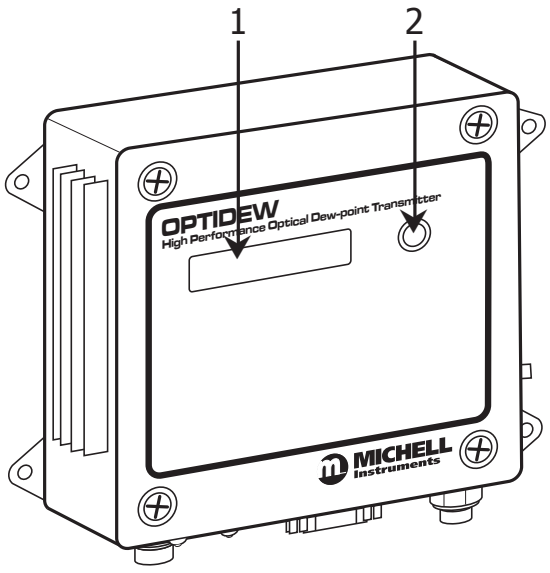
Optidew Vision

The Optidew Vision is designed to be bench mounted and is supplied with a tilting carry handle, but it can also be panel mounted using the optional panel mounting kit (Michell order code: OPV-PMK).

2.2 Instrument Connections

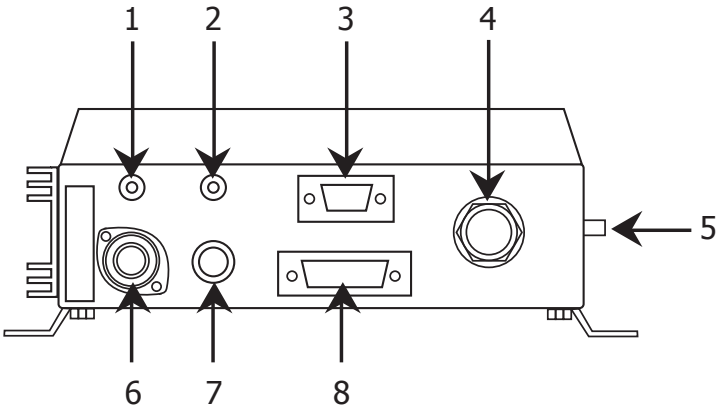
Optidew

Front Panel



Number	Description
1	**Display (optional)** Shows measured or calculated instrument parameters. Refer to Section 3.1.
2	**Display Control (with Display models only)** Switches between different display screens, and puts the instrument in REMOTE MODE. Refer to Section 3.2.

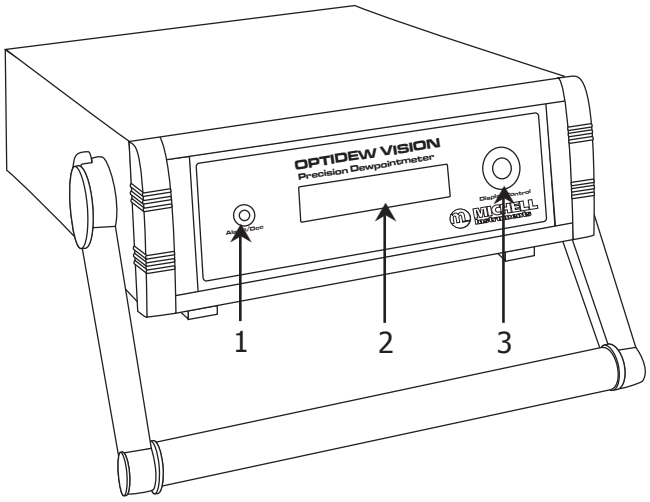
Bottom Panel



Number	Description
1	**Power LED** Indicates that the Optidew is powered.
2	**Status LED** Lit to indicate instrument is in DCC or DATA HOLD mode. Flashes in the event of an Optics fault. This normally means the mirror needs cleaning, followed by resetting the mirror condition during a DCC cycle. Refer to Section 5 for more details.
3	**Serial Connector** For digital serial communications. Refer to Section 2.4.
4	**Sensor Connector** Used for connecting the Optidew sensor via the sensor cable.
5	**Mounting Point** For integral sensor version.
6	**Power Connector** Universal power input 90 to 264 V AC OR 127 to 370 V DC, 47 to 440 Hz
7	**Temperature Connector** For connection of remote PT100 temperature probe.
8	**Output Connector** Two current outputs, and two relay connections. Refer to Section 2.3.

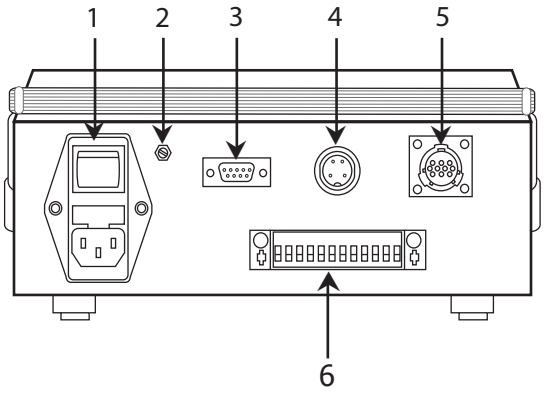
2.2.1 Optidew Vision

Front Panel



Number	Description
1	**Status LED** Lit to indicate instrument is in DCC or DATA HOLD mode. Flashes in the event of an Optics fault. This normally means the mirror needs cleaning, followed by resetting the mirror condition during a DCC cycle. Refer to Section 5 for more details.
2	**Display** Shows measured or calculated instrument parameters. Refer to Section 3.1.
3	**Display Control** Switches between different display screens, and puts the instrument in REMOTE Mode. Refer to Section 3.2.

Rear Panel



Number	Description
1	**Universal power input 90 to 264 V AC OR 127 to 370 V DC, 47 to 440 Hz** Features integrated ON/OFF switch, and fuse holder. Fuse Type: 2A, Quick blow, Glass, 20 x 5mm
2	**Mirror Condition Potentiometer** Used to adjust mirror condition during a DCC cycle. Refer to Section 3.3.7.
3	**Serial Connector** For digital serial communications. Refer to Section 2.4.
4	**Temperature Connector** For connection of remote PT100 temperature probe.
5	**Sensor Connector** Used for connecting the Optidew sensor via the sensor cable.
6	**Output Connector** Two current outputs, and two relay connections. Refer to Section 2.3.

2.3 Electrical Power Connections

WARNING:

The instrument must be GROUNDED.

The Optidew and Optidew Vision accept a power supply of the following specification:

Voltage	90 to 264 V AC OR 127 to 370 V DC
Frequency	47 to 440 Hz
Power Consumption	20 W max

Optidew

The Optidew is supplied as standard with a fully waterproofed power connector with a 2m (6.5ft) cable.

This power connector is wired as follows:

Pin	Connection	Conductor Color
Pin 1	Live (Line Voltage)	Brown
Pin 2	N/C	N/A
Pin 3	Neutral	Blue
⏚	Ground	Green & Yellow

NOTE: The Optidew is designed for continuous operation and therefore does not feature a power on/off switch. As soon as power is applied, the green power LED will illuminate and the transmitter will initiate a DCC cycle, illuminating the system status LED.

The part number for a replacement power cable is OPT-POWER-CAB-2.

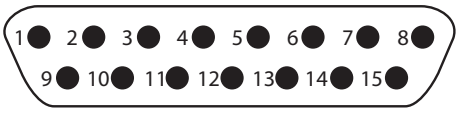
Optidew Vision

The Optidew Vision is supplied with a 2m (6.5ft) IEC cable. The IEC socket on the back of the instrument features an integrated ON/OFF switch and fuse holder that accepts a 2A, Quick blow, Glass, 20 x 5mm fuse.

2.3.1 Analog Outputs

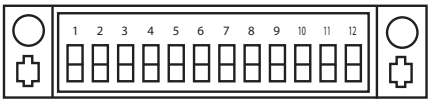
The analog output connector is located on the front panel of the Optidew, and on the rear panel of the Optidew Vision. The electrical connections are shown below:

Optidew



15-Way D Connector

Optidew Vision



12-Way Output Connector

Pin	Description	Pin	Description
1	Channel 1 Current Output	1	Status Relay N/C
2	Channel 1 Ground	2	Status Relay COM
3	Channel 2 Current Output	3	Status Relay N/O
4	Channel 2 Ground	4	Optics Fault / Alarm Relay N/C
5-8	Not Connected	5	Optics Fault / Alarm Relay COM
9	Optics Fault / Alarm Relay N/O	6	Optics Fault / Alarm Relay N/O
10	Optics Fault / Alarm Relay COM	7	Channel 1 Current Output
11	Optics Fault / Alarm Relay N/C	8	Channel 1 Ground
12	Status Relay N/O	9	Channel 2 Current Output
13	Status Relay COM	10	Channel 2 Ground
14	Status Relay N/C	11-12	Screen
15	Not Connected		

2.3.2 Current Outputs

Two current source outputs are provided which can be set to either 4-20 or 0-20 mA and scaled by the user over the range –200 to +1000 by using the supplied application software (see Section 3.4) or by sending the appropriate commands to the instrument over RS232 or RS485 (see Appendix B).

Channel 1 can be set for dew point, %RH, gm^{-3}, gkg^{-1} or delta (t-tdp).

Channel 2 always outputs temperature.

When the output is under-range, or over-range, the output signal will be 23mA.

2.3.3 Relay Outputs

There are two sets of relay outputs available via the output connector:

- Alarm Relay

  This relay changes state to indicate that the process variable has exceeded the alarm set point value. The alarm set point value can be adjusted using the supplied application software (see Section 3.4) or by sending the appropriate commands to the instrument over RS232 or RS485 (see Appendix B).

- Status Relay

  This relay changes state when the instrument is in DCC, DATA HOLD.

In the event of an optics fault, both relays will change state, and the status LED will flash. This normally means the mirror needs cleaning, followed by resetting the mirror condition during a DCC cycle. Refer to Section 5 for more details.

Refer to Section 2.3 for wiring details.

2.4 Digital Communications Port

The Optidew Series provides either RS232 or RS485 serial communications via a 9 way D-type connector. This allows for communication with a PC, data logger, or other hardware device.

The following communication settings are required:

Baud Rate	9600
Data Bits	8
Stop Bit	1
Parity	None

Pin No	RS232	RS485
2	Tx	B
3	Rx	A
5	GND	GND

For information on installing and using the supplied application software please refer to Section 3.4.

For a list of serial commands please refer to Appendix B.

NOTE: Changing between RS232 and RS485 communication requires hardware modifications and can only be carried out at the factory.

NOTE: Instruments with a display will only communicate when the display shows REMOTE mode. (see Section 3.2).

2.5 Sensor Installation

The dew-point sensor contains the optical system and the chilled mirror. It is fitted with a bayonet connector to allow easy and secure connection to the instrument using the supplied sensor cable.

The available options for sensor installation are:

- via a permanently installed sample port into which the remote sensor can be inserted or
- via a sensor block immediately attached to the sensor around which the sample circulates or
- in an ambient environment where the sample is diffusing through the sensor.

If the instrument is to monitor the conditions in an environment, the sensor must be located in a representative position, i.e. not under an air conditioning vent. **NOTE: It is recommended that the sensor is fitted with either an HDPE or stainless steel sintered guard to baffle it from flowing air currents.**

If the sensor is to be mounted directly into the process, tap a hole for fitment of the widest thread (M36 x 1.5-6g), and seal using the Dowty washer provided.

1. Before connecting ensure that the sensor mirror surface is fully cleaned. See Section 5 (Maintenance) for cleaning details.
2. If the sensor is installed within a sealed gas system it must be fixed securely without any possibility of leaks. Ensure that the sample flow across the sensor is correctly regulated.
3. The gas connections for the remote sensor are either via a permanently installed sample port into which the remote sensor can be inserted or via a sensor block (see *Figure 3)* immediately attached to the sensor around which the sample circulates. Gas sample entry into the sensor block is via couplings that can be installed via ⅛" NPT female threads. A Dowty washer is provided to seal the connection between the sensor and the block.
4. If the sensor is to be positioned into a sealed but open environment, e.g. glove box, environmental chamber or area to be monitored, ensure that the sensor is suitably secured to prevent any movement and that it is located in a position that will see a representative flow of the sample to be measured.
5. Connect the remote sensor cable to the sensor and to the instrument via the connector on the rear panel. The connector is a 2-part bayonet fitting. Insert the cable part and rotate until the polarization lugs engage. Rotate the outer collar of the cable-mounted part in a clockwise direction, and, at the same time, push the connector halves together to assist the mating. The connection is made in a ¼ of a turn of the outside collar part.

6. If the remote temperature probe is to be utilized, ensure that the probe is suitably secured to prevent any movement and that it is located in a position that will see a representative flow of the sample to be measured.

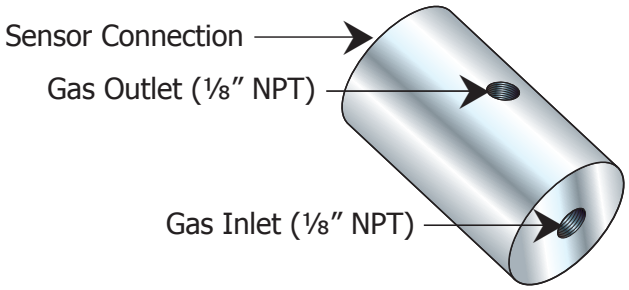


Figure 3 *Sample Block*

Michell Instruments can supply various sampling accessories including a locknut kit for mounting the sensor in an ambient environment.

More complete sampling guidelines are available in Section 4.1.

2.5.1 Integral Sensor Configuration

The Optidew sensor can be fitted directly to the bayonet-type connector on the case of the instrument without using a sensor cable. A retaining bracket provides support for the sensor. **NOTE: This is not possible with the Optidew Vision.**

Installation / Removal

1. Connect the sensor to the bayonet-type connector on the case of the Optidew.
2. Fit the retaining bracket (configuration drawing shown in Appendix D.1).
3. Secure the retaining bracket with the supplied locking nut.
4. Fit the optional sintered, or HDPE sensor guard, if required.

Follow the instructions in reverse to remove the sensor.

2.6 Remote Temperature Probe

The temperature probe is supplied pre-wired and simply needs to be fitted to the connector on the Optidew or Optidew Vision prior to use.

The temperature probe can be safely disconnected or reconnected from the instrument at any time.

3 OPERATION

First Time Operation

Before using the instrument it is recommended to read through the Installation, Operation and Maintenance Sections of this manual.

1. Clean the sensor mirror according to Section 5.1.
2. Install the sensor according to Section 2.5.
3. Set the flow to within 0.1 to 2Nl/min (optimal 0.5Nl/min).
4. After making all necessary electrical connections, power on the instrument.
5. During the DCC phase, reset the mirror condition according to Section 3.3.7.
6. If serial communication is required, and the instrument has a display it must be placed in Remote Mode, see Section 3.2.

3.1 Display

The Optidew is available with an optional VFD (Vacuum Fluorescent Display) fitted on the top panel of the instrument. The Optidew Vision features a front panel VFD. When power is applied to the Optidew or Optidew Vision the display will momentarily show test characters, after which the start-up banner will be displayed for approximately 7 seconds.

3.2 LOCAL and REMOTE modes

To the right of the display is a multi-function button.

Pressing the button in LOCAL mode scrolls through the available display screens.

Pressing and holding the button for 7 seconds toggles between LOCAL and REMOTE mode.

NOTE: The display must have finished showing the start-up banner before changing modes.

In LOCAL mode, RS232 or RS485 output is disabled and communication with a PC is not possible. The measured and calculated parameters are shown on the display on a number of different screens as shown in Section 3.2.1.

In REMOTE mode the display is inactive, and shows ***REMOTE MODE***. The RS232 or RS485 output is now enabled and available via the 9 pin communication D-connector. This functionality is the same as the non-display version of the Optidew.

3.2.1 Screens

Below is a description of the parameters and system status information shown on each screen.

Screen 1: Displays the status of the Optidew
It will show DCC, DATA HOLD, OPTICS ALARM or MEASURE according to the current status of the Optidew instrument

Screen 2: Peltier Power and the Mirror Condition
Refer to Section 3.3.7

Screen 3: % RH and ambient temperature

Screen 4: Dew point and ambient temperature

Screen 5: Humidity in gkg-1 and ambient temperature

Screen 6: Humidity in gm-3 and ambient temperature

Screen 7: Δ (t – tdp) and ambient temperature
This is the difference between ambient temperature and dew point. **NOTE: This parameter will be equal to 0 if the dew point is higher than the ambient temperature (e.g. during a DCC cycle)**

Screen 8: a_w
Equivalent to RH/100 and ambient temperature

3.3 Operational Functions

3.3.1 Operating Principle

The system operates on the chilled mirror principle, whereby a gas sample is passed over the surface of a polished mirror contained within the open sensor housing. At a temperature dependent upon the moisture content in the gas, and the operating pressure, the moisture in the gas condenses out on the surface of the mirror.

An optical system is used to detect the point at which this occurs. This information is used to control the mirror temperature and maintain a constant thickness of the condensation layer on the mirror surface.

The system operates by illuminating the mirror with an LED. The light reflected back is measured by a photo detector and this amount of light is recorded as a reference point. As moisture builds up on the mirror the level of light reflected will decrease. By comparing this signal with the reference point at any time, the system will be able to control the Peltier drive circuit to either heat or cool the mirror in order to maintain the desired condensation film thickness on the mirror surface.

At an equilibrium point, where the evaporation rate and condensation rate at the surface of the mirror are equal, the mirror temperature, read by a Pt100 platinum resistance thermometer embedded in the mirror, represents the dew point.

3.3.2 Operating Cycle

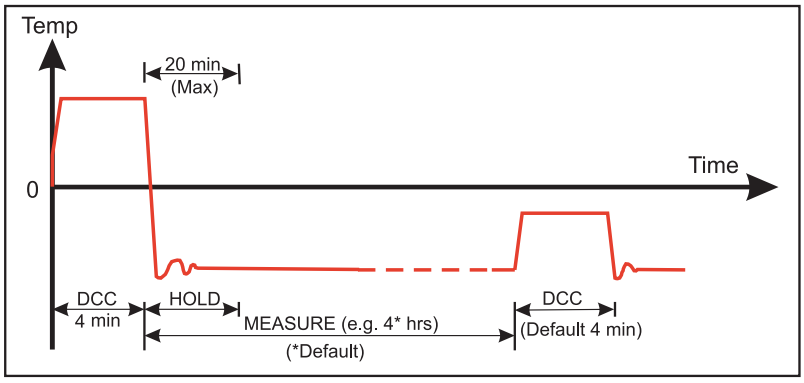


Figure 4 *Operating Cycle*

At initial switch-on, the instrument enters a DCC cycle for 4 minutes. This heats the mirror 20°C (36°F) above the sensor temperature. This ensures that all moisture is driven off the surface of the mirror.

The mirror is maintained at this temperature for the DCC duration. During the DCC cycle, DATA HOLD fixes the Channel 1 mA output at the value read before DCC commenced. DATA HOLD typically lasts 4 minutes from the end of a DCC cycle, or until the instrument has reached the dew point. This procedure is in place to prevent any system which is connected to the outputs from receiving a 'false' reading.

After the DCC period has finished, the measurement period commences, during which the control system decreases the mirror temperature until it reaches the dew point. The sensor will take a short amount of time to settle on the dew point. The length of this stabilization time depends upon the temperature of the dew point. The end of a DCC cycle resets the interval counter, meaning that another DCC will start (by default) in 4 hours time. Once the measurement is stable, DATA HOLD will release, and the Channel 1 mA output will resume normal operation.

3.3.3 DCC

Dynamic Contamination Control (DCC) is a system designed to compensate for the loss of measurement accuracy which results from mirror surface contamination.

During the DCC process the mirror is heated to approximately 20°C above the sensor temperature to remove the condensation which has formed during measurement.

The surface finish of this mirror, with the contamination which remains, is used by the optics as a reference point for further measurements. This removes the effect of contamination on accuracy.

At switch-on, the system initiates a DCC to measure the surface condition of the mirror. The status LED will be lit to indicate a DCC is in progress and the Channel 1 mA output will be fixed at 23 mA. The end of the DCC duration will result in the system resuming automatic control of the mirror temperature and cooling the mirror surface to form condensation. The instrument will be in DATA HOLD mode until the instrument has settled on the dew point and the measurement is stable.

For more information about the operating cycle of the Optidew, and DATA HOLD mode refer to Sections 3.4.2 and 3.4.4.

3.3.4 DATA HOLD Phase

During DATA HOLD, the level of the Channel 1 mA output is held and the Status Relay and Status LED are energized and illuminated respectively, until the system has stabilized onto the measured dew point. The DATA HOLD phase will finish when the following two conditions are met:

- The minimum hold time has expired and
- The system is stable to within a specified stability band

The minimum hold time is nominally set to 4 minutes, and generally, under most conditions, the system will be stable within this time period. However, there may be some conditions where the system may take longer to stabilize, so under these conditions an adaptive hold algorithm takes over to determine when stability is reached. If, under extreme conditions, the system fails to stabilize within the set stability band, the DATA HOLD phase will terminate when the maximum hold time is reached.

When the DATA HOLD phase finishes - the Status LED will turn off, the Status Relay will de-energize and the hold on Channel 1 mA output will be released. The system will now be in its continuous measurement phase, where it will remain until the measurement time has elapsed and the next DCC cycle initiates.

3.3.5 MAXCOOL

The MAXCOOL function over-rides the dew-point control loop and applies maximum cooling drive to the Peltier heat pump. It can be used:

- to determine what temperature the mirror can be driven down to with reference to the sensor body. This temperature is indicated on the display.
- to determine whether or not the instrument is controlling at the dew point and whether it is able to reach it. This situation could, for instance, arise when attempting to measure very low dew points where, possibly due to a high ambient temperature, the Peltier heat pump is unable to depress the temperature far enough to reach the dew point.
- to determine whether the instrument is controlling by switching MAXCOOL on for a short period and then switching MAXCOOL off. This will depress the mirror temperature briefly and when switched off the control loop should be able to stabilize the mirror temperature at the dew point again.

The MAXCOOL function can be turned on and off using the application software, or by sending commands to the instrument using the digital communications port.

3.3.6 FAST –Frost Assurance System Technology

Theoretically, it is possible for water to exist as a super-cooled liquid at temperatures down to -40°C (-40°F). A gas in equilibrium with ice is capable of supporting a greater quantity of water vapor at a given temperature than a gas in equilibrium with liquid water. This means that a measurement below 0°C taken over water will read approximately 10% lower than the same measurement taken over ice.

When turned on, the Optidew's FAST system identifies when the measured dew point is between -40 and 0°C (-40 and +32°F) and automatically decreases the mirror temperature until a pre-determined film thickness of condensate is detected. This ensures the formation of ice on the mirror. The mirror temperature is then increased to above the initial measured dew point, but maintained below 0°C (+32°F), and the excess condensate is driven off the mirror. The instrument then continues operation as normal – once ice has formed it will remain as ice until the temperature is raised above 0°C (+32°F).

FAST can only be enabled or disabled by sending the appropriate command to the Optidew via the digital communications port. Refer to Appendix B for a complete list of instrument commands.

3.3.7 Mirror Condition and Peltier Power

Peltier Power indicates how much the heat pump is depressing in order to measure the dew point. When the peltier power has a value of 100% and does not reduce over an extended period of time, it means that the heat pump is at maximum depression. In normal operation this indicates that the dew point is lower than the present mirror temperature and therefore cannot be measured. Reducing the sensor ambient temperature by use of additional cooling will increase the measurement range of the instrument in applications where the peltier power >95%.

NOTE: Operating the sensor at the limits of its depression capability for extended periods may cause premature wear to the heat pump.

Alongside the peltier power value is an indicator that shows the control stability. When this indicator shows CNTRL, it indicates the system is controlling the mirror temperature on the dew point. COOL indicates the system is depressing the heat pump in order to form dew on the mirror surface. HEAT indicates a rapid increase in dew-point level, whereby the system needs to increase the temperature of the mirror surface to read this new dew-point value.

The Mirror Condition indicates the amount of signal received back from the mirror which includes both the level of moisture and contamination on the mirror surface. In DCC mode this display will only show the amount of mirror contamination and, if greater than 80% after a DCC, will initiate an optics alarm condition.

NOTE: It is recommended to clean the mirror and reset the mirror condition before an Optics fault occurs. Refer to Section 5 for further instructions.

3.4 Optisoft Application Software

The Opti-Soft application software is an interface to the Optidew Series that provides a display of the measured and calculated parameters, system status, charting and logging, statistical information and a facility to view and change the system parameters.

NOTE: If your Optidew Series instrument is fitted with a display, Communication with the software is only possible when the unit is in REMOTE MODE **(see Section 3.2).**

3.4.1 Virtual Hygrometer Window

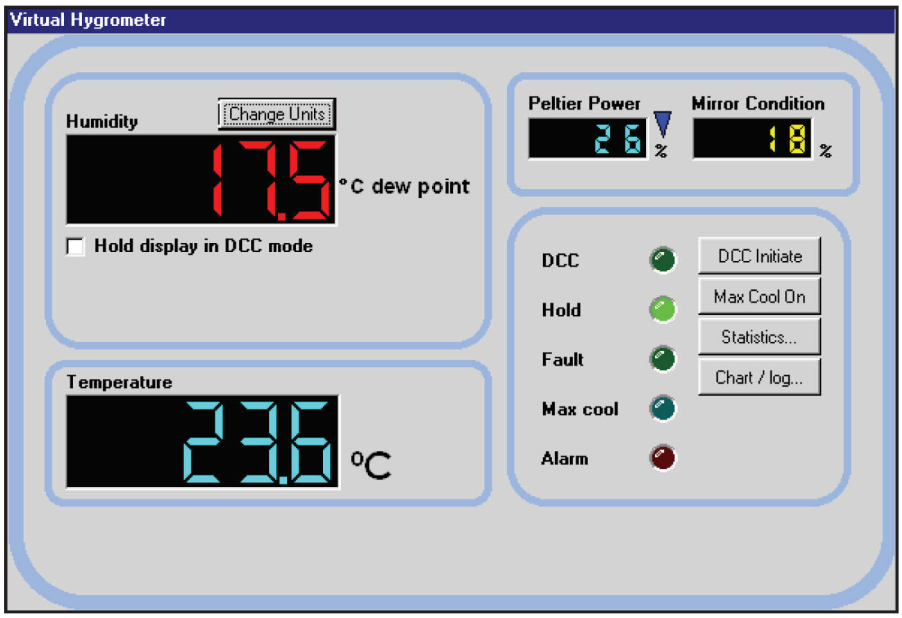


Figure 5 *Virtual Hygrometer Window*

The Humidity Display has the ability to show dew point (°C/°F), %RH, gm^{-3}, gkg^{-1}, Δ (t – tdp) or a_w by clicking on the **Change Units** button.

Selecting one of these options will show the measured or calculated value, but will not change the Channel 1 mA output of the instrument, as this can only be done via the Parameter Setup window, see Section 3.4.4.

When the software is executed, the displayed units will default to the present setting of Channel 1 mA output. The ambient temperature is shown in the lower display.

NOTE: The humidity display will blink if the dew point is higher than the temperature. This is normal and not a fault.

3.4.2 Mirror Condition

Mirror Condition indicates the amount of signal received back from the mirror, which includes both the level of moisture and contamination on the mirror surface. In DCC mode this display will only show the amount of mirror contamination and, if greater than 80% after a DCC, the optics fault alarm will be activated. This normally means the mirror needs cleaning, followed by resetting the mirror condition during a DCC cycle. A low mirror signal level is indicated by a flashing 0%, indicating it should be reset during a DCC cycle.

Refer to Section 5 for more details.

3.4.3 Instrument Status

Instrument status is shown on the five colored indicators.

Status Indicator	Description
DCC **HOLD**	In DCC (initiated automatically or by using the **DCC Initiate** button), both the DCC and HOLD indicators will illuminate showing the DCC status and the hold on Channel 1 mA output. When the DCC period ends, the DCC indicator will turn off leaving only the HOLD indicator illuminated until the system enters the measurement phase. Refer to Section 3.3.3 for more details.
Fault	The Fault indicator will illuminate after a DCC if cleaning of the mirror surface is required. This normally means the mirror needs cleaning, followed by resetting the mirror condition during a DCC cycle. Refer to Section 3.4.2 for more details.
MAXCOOL	The MAXCOOL indicator will illuminate to indicate the MAXCOOL function has been activated. The system will drive the heat pump into maximum depression. This feature can be used to ascertain if the measured dew point is within the measurement capability of the instrument. **NOTE: It is necessary to manually deactivate the MAXCOOL function.** Refer to Section 3.3.5 for more details.
Alarm	The alarm indicator will illuminate when the measured variable exceeds the alarm set point (if selected). Refer to Section 2.3.3 and 3.3.4 for more details.

Clicking on the **Statistics** button allows maximum, minimum and average values of the measured parameters to be viewed. See Section 3.4.6.

Charting and logging of the measured values can be initiated by clicking on the **Chart/log** button. See Section 3.4.5.

The **Hold display in DCC mode** check box stops the system from updating the display during DCC, when enabled. The display is held when a DCC is initiated and is not updated until both DCC and HOLD periods have expired.

3.4.4 Parameter Setup

The Parameter Setup window allows the setting and ranging of Channel 1 and 2 mA outputs, the duration for DCC, HOLD, and Measurement, and the values for atmospheric pressure and alarm set points.

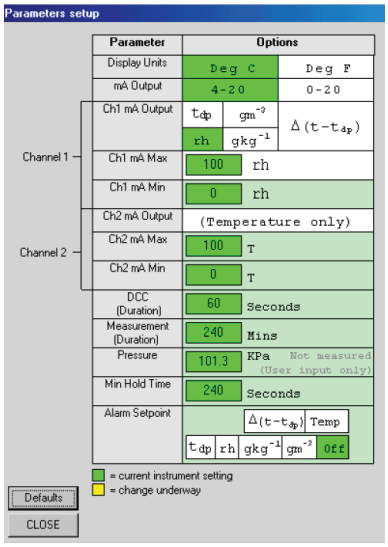


Figure 6 *Parameter Setup Window*

The display units and Channel 1 mA output are selected by left clicking in the relevant box. This will change the settings of both the instrument and the virtual hygrometer window. Changing the mA outputs from 4-20 mA to 0-20 mA & vice versa will change both Channel 1 & Channel 2 mA outputs.

The maximum and minimum values of Channel 1 and Channel 2 are –200 to +1000 respectively, allowing the range of the outputs to be anywhere between these limits. The values for Max and Min must be whole numbers with a difference between them of at least 1°C/F.

If Channel 1 is to be set for % RH, gm^{-3}, gkg^{-1} or Δ (t – tdp), then the minimum value of Channel 1 Min should be 0, as a negative value for these parameters is not possible. The pressure value is used to correct gm^{-3} and gkg^{-1} for atmospheric pressure. By entering the atmospheric pressure the display and Channel 1 mA output (if either gm^{-3} or gkg^{-1} is selected) will both be corrected accordingly.

The Alarm can be set to OFF or set to be active on any of the process variables, i.e. dew point, ambient temperature, temperature difference, % RH, gm^{-3} or gkg^{-1} as shown above. The set point needs to be an integer value between –200 and +1000, although negative set points are only valid for dew point and ambient temperature. If the process variable exceeds the set point, the alarm indicator on the virtual hygrometer will illuminate and the Optics Fault/Alarm Relay will change state.

To change any of the values, enter the required value and click on the return key. The background of the text box will change to yellow to indicate that the change is taking place. When confirmation has been received that the instrument has accepted the change, the background will change back to green.

NOTE: When the Parameter Setup window is open, the values in the Virtual Hygrometer window are frozen. The Parameter Setup window needs to be closed for the software to resume normal display mode.

3.4.5 Charting and Logging

Clicking on the **Chart/log** button in the Virtual Hygrometer window brings up the Chart / log control panel window.

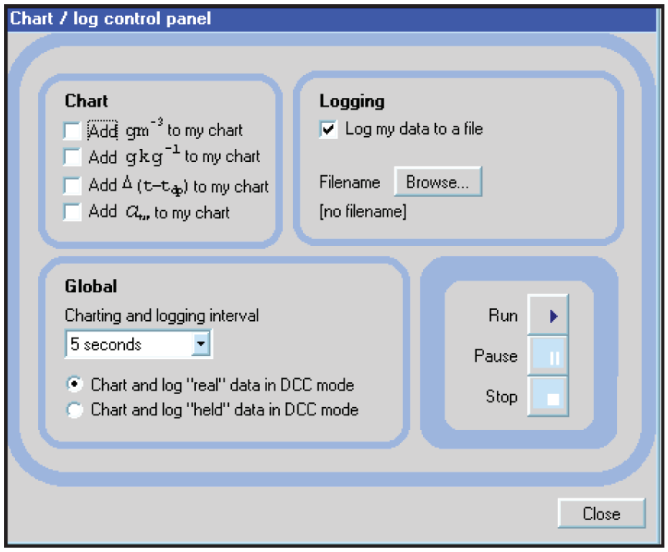


Figure 7 *Chart/Log Control Panel Window*

The chart, in its default configuration, displays dew point, temperature and % RH. However, gm^{-3}, gkg^{-1} and $\Delta(t - t_{dp})$ can be added by clicking in the appropriate check box.

Within the **Global** section, the charting and logging interval is selected from a minimum of 5 seconds to a maximum of 1 hour. It offers the facility to log the temperature of the mirror while in DCC and HOLD, or hold the measured value while in these modes and chart the held data values accordingly.

To log the measured and calculated humidity values to a data file for further analysis, click on the check box in the **Logging** section and specify a file name by clicking on the **Browse** button. If a log file is not required simply uncheck the box.

To Run, Pause and Stop the charting and logging facility, use the chart control buttons accordingly.

Clicking on the **Run** button will bring up the chart as shown in *Figure 7.* The chart shows the measured and calculated humidity values selected in the **Chart** section, with an assigned identifiable color for each value. It is possible to scale, zoom and scroll both the X and Y axis of the chart by using the controls in the Chart Settings window, which can be activated by clicking on the **Chart Settings** button in the Chart window.

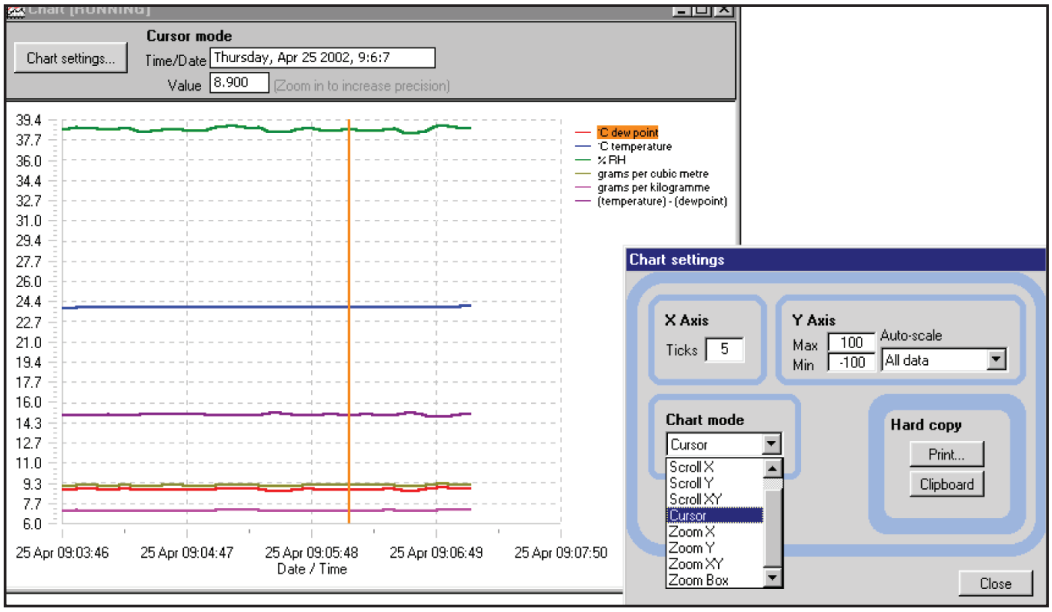


Figure 8 *Chart Window*

3.4.6 Statistics

Clicking on the **Statistics** button on the Virtual Hygrometer window will display the Basic statistics window as shown below:

This window shows the maximum, minimum and average of each parameter since the program began taking readings from the instrument, or since the **Reset** button was pressed.

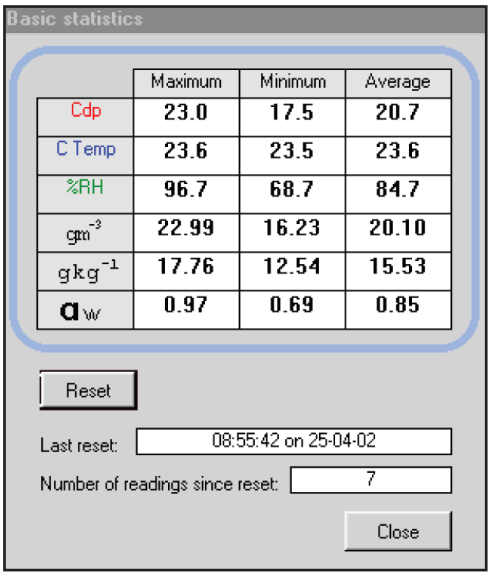


Figure 9 *Basic Statistics Window*

3.4.7 Control Parameters

The control parameters (protected by a password) should only be amended by trained personnel in order to adjust the system for operation in extreme conditions.

Contact a Michell Technical Representative for details (see contact information at www.michell.com).

3.4.8 Calibration Correction

Every Optidew is delivered with a Calibration Certificate detailing the deviation at each measurement point from a known reference value. Data provided on the Calibration Certificate is normally arranged as shown in the following extracts:

Extract from a UKAS Calibration Certificate:

Generated Dew point °C	Test Hygrometer			
	Dew-point Temperature °C	Sensor Temperature °C	Correction Required °C	Expanded Uncertainty °C
-39.89	-40.11	-20	+0.22	±0.26
-20.10	-20.31	0	+0.21	±0.22
0.39	0.20	21	+0.19	±0.18

Extract from a Standard Calibration Certificate:

Generated Dew point °C	Instrument Display °C
-40.1	-40.2
-20.1	-20.1
0.2	0.1

Figure 10 *Extracts from Calibration Certificates*

From time to time the Optidew may be calibrated by an external calibration agency, where similar data will be provided.

The Calibration Correction window is a utility that allows an authorized user to input calibration information in order to effect a real-time correction of the displayed, charted and logged data within the Opti-Soft application software.

Data for dew-point temperature and ambient temperature, both in units of °C, may be entered for correction purposes, along with the original Calibration Certificate reference number and date of calibration, providing full traceability of data. Once the correction data has been applied, by clicking on the check box, the main Virtual Hygrometer window will indicate that corrected data is being displayed and will show the Calibration Certificate number and date. This information is also saved to the **Log** file for data export.

Figure 11 shows the Calibration Correction window. Four sets of data may be entered:

DP Ref	Dew-point data for the reference hygrometer (sometimes called the actual dew point or the standard)
DP Reading	Measured dew-point value of the Optidew under test
Temp Ref	Temperature data from the reference thermometer
Temp Reading	Measured temperature value of the Optidew under test

Data can be entered for between 3 and 11 different dew-point and temperature calibration points. If no data is inserted, no calibration correction is possible. Data should be entered with the highest dew-point and temperature values at the top of the page, in descending value order to the bottom. If out-of-sequence data or spurious characters are entered, the software will raise a warning message and bad data must be re-entered.

The **Calibration Certificate Number** section is an optional entry field and is alphanumeric. Any information entered into this field will be displayed on the main Virtual Hygrometer window when calibration correction is enabled. In addition it will be saved to the **Log** file. Similarly, the date of calibration may be entered for display and logging when correction is enabled.

Once all necessary data has been entered in the Calibration Correction window, click on the **Use Calibration Date to Correct Measure Values** check box and then click on **Apply** and **Close** to return to the main Virtual Hygrometer display. Upon the next update, the corrections entered will be applied to all displayed and logged data, and a legend above the display will indicate this fact. To remove the Calibration Correction window, de-select the check box, click on **Apply**, then click on **Close.**

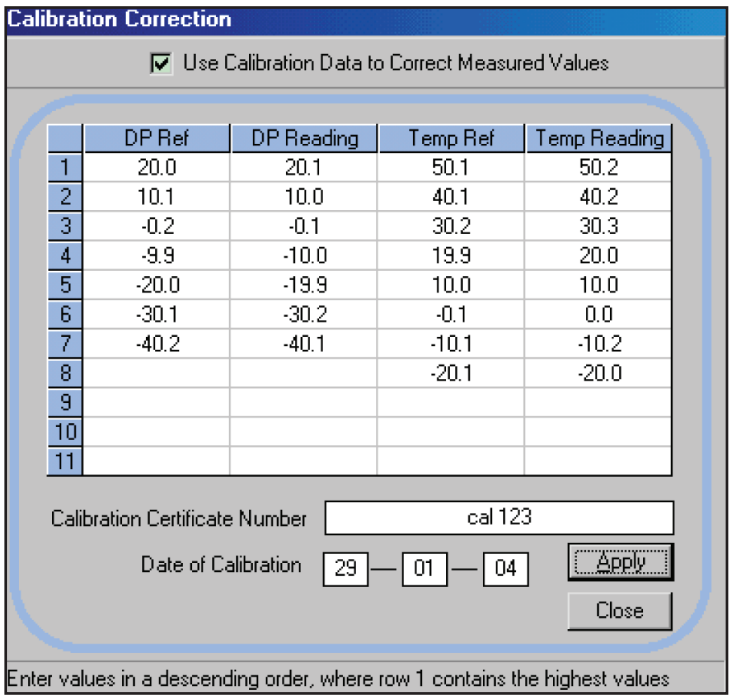


Figure 11 *Calibration Correction Window*

NOTE: Enter the calibration data in descending order so the highest values are in row 1 as shown above.

3.4.9 Change of Password

The initial password is **Michell**. This can be changed after entering the Control and Calibration Data windows. Selecting the **Change Password** menu item will display the following window where you can enter a new password with up to 20 alphanumeric characters. The password is not case sensitive.

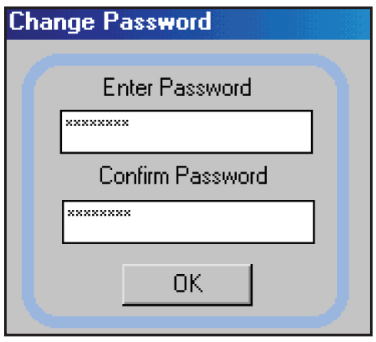


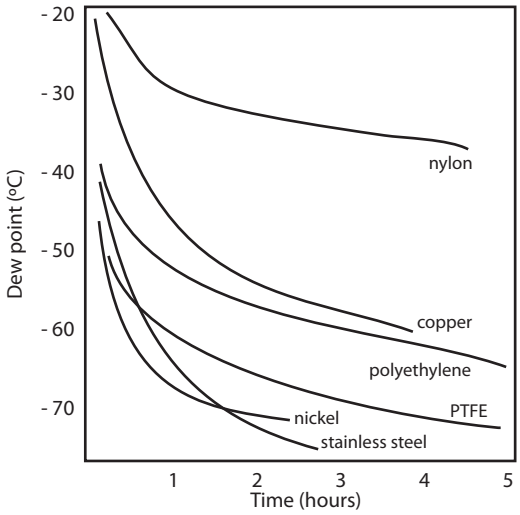
Figure 12 *Change Password Window*

4 GOOD MEASUREMENT PRACTICE

4.1 Sampling Hints

Measurement of moisture content is a complex subject, but does not need to be difficult. This section aims to explain the common mistakes made in measurement situations, the causes of the problem, and how to avoid them. Mistakes and bad practices can cause the measurement to vary from the expectation; therefore a good sampling technique is crucial for accurate and reliable results.

Transpiration and Sampling Materials



All materials are permeable to water vapor, as the water molecule is extremely small compared to the structure of solids, even when compared to the crystalline structure of metals. The graph above shows the dew point inside tubing of different materials when purged with very dry gas, where the exterior of the tubing is in the ambient environment.

Many materials contain moisture as part of their structure, particularly organic materials (natural or synthetic), salts (or anything which contains them) and anything which has small pores. It is important to ensure that the materials used are suitable for the application.

If the partial water vapor pressure exerted on the outside of a compressed air line is higher than on the inside, the atmospheric water vapor will naturally push through the porous medium causing water to migrate into the pressurized air line. This effect is called transpiration.

Adsorption and Desorption

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to the surface of a material, creating a film. The rate of adsorption is increased at higher pressures and lower temperatures.

Desorption is the release of a substance from or through the surface of a material. In constant environmental conditions, an adsorbed substance will remain on a surface almost indefinitely. However, as the temperature rises, so does the likelihood of desorption occurring.

In practical terms, as the temperature of the environment fluctuates, water molecules are adsorbed and desorbed from the internal surfaces of the sample tubing, causing small fluctuations in the measured dew point.

Sample Tubing Length

The sample point should always be as close to the critical measurement point as possible, in order to obtain a truly representative measurement. The length of the sample line to the sensor or instrument should be as short as possible. Interconnection points and valves trap moisture, so using the simplest sampling arrangement possible will reduce the time it takes for the sample system to dry out when purged with dry gas.

Over a long tubing run, water will inevitably migrate into any line, and the effects of adsorption and desorption will become more apparent. It is clear from the graph shown above that the best materials to resist transpiration are stainless steel and PTFE.

Trapped Moisture

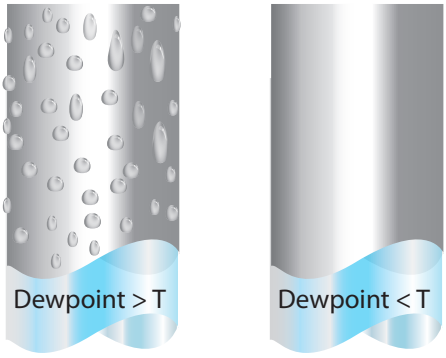
Dead volumes (areas which are not in a direct flow path) in sample lines, hold onto water molecules which are slowly released into the passing gas; this results in increased purge and response times, and wetter than expected readings. Hygroscopic materials in filters, valves (e.g. rubber from pressure regulators) or any other parts of the system can also trap moisture.

Sample Conditioning

Sample conditioning is often necessary to avoid exposure of sensitive measuring components to liquids and other contaminants which may cause damage or affect the accuracy over time, depending on the measurement technology.

Particulate filters are used for removing dirt, rust, scale and any other solids that may be in a sample stream. For protection against liquids, a coalescing filter should be used. The membrane filter is a more expensive but highly effective alternative to a coalescing filter. It provides protection from liquid droplets, and can even stop flow to the analyzer completely when a large slug of liquid is encountered.

Condensation and Leaks



Maintaining the temperature of the sample system tubing above the dew point of the sample is vital to prevent condensation. Any condensation invalidates the sampling process as it changes the water vapor content of the gas being measured. Condensed liquid can alter the humidity elsewhere by dripping or running to other locations where it may re-evaporate.

The integrity of all connections is also an important consideration, especially when sampling low dew points at an elevated pressure. If a small leak occurs in a high pressure line, gas will leak out but vortices at the leak point and a negative vapor pressure differential will also allow water vapor to contaminate the flow.

Flow Rates

Theoretically flow rate has no direct effect on the measured moisture content, but in practice it can have unanticipated effects on response speed and accuracy. The optimal flow rate varies depending on the measurement technology, and can always be found in the instrument or sensor manual.

An inadequate flow rate can:

- Accentuate adsorption and desorption effects on the gas passing through the sampling system.
- Allow pockets of wet gas to remain undisturbed in a complex sampling system, which will then gradually be released into the sample flow.
- Increase the chance of contamination from back diffusion: ambient air that is wetter than the sample can flow from the exhaust back into the system. A longer exhaust (sometimes called a pigtail) can also help alleviate this problem.
- Slow the response of the sensor to changes in moisture content.

An excessively high flow rate can:

- Introduce back pressure, causing slower response times and unpredictable effects on equipment such as humidity generators.
- Result in a reduction in depression capabilities in chilled mirror instruments by having a cooling effect on the mirror. This is most apparent with gases that have a high thermal conductivity such as hydrogen and helium.

POSSIBLE INJURY! The tubing, valves and other apparatus attached to this instrument must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystander is possible.

Before disconnecting the instrument from the gas line it is essential to vent the system to atmospheric pressure, otherwise severe injury could result.

5 MAINTENANCE

Failure to follow these maintenance procedures may result in premature wear or damage to the heat pump.

5.1 Sensor Mirror Cleaning

Throughout the life of the instrument, periodic cleaning of the mirror surface and optics window may be required. The frequency of this depends upon operating conditions and the potential in the application for contaminants to be deposited on the mirror. Sensor cleaning is mandatory if the instrument indicates an optics fault.

The cleaning procedure is as follows:

1. Switch off the instrument and remove the sensor from its sample block.
2. Clean the mirror surface and optics window with a cotton bud/Q-Tip soaked in distilled water. If the sensor has been exposed to oil based contamination then use one of the following solvents: methanol, ethanol, or isopropyl alcohol. To avoid damage to the mirror surface do not press too firmly on the cotton bud/Q-Tip when cleaning. Allow the cleaning solvent to fully evaporate.
3. Reset the mirror condition according to the instructions in Section 5.2.

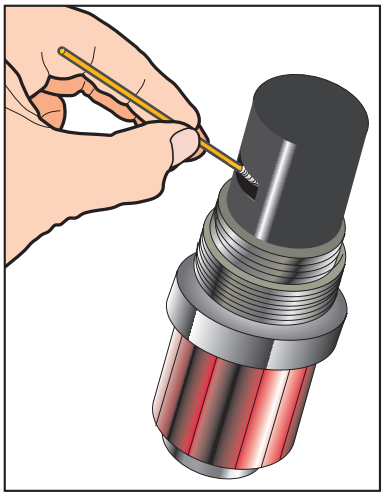
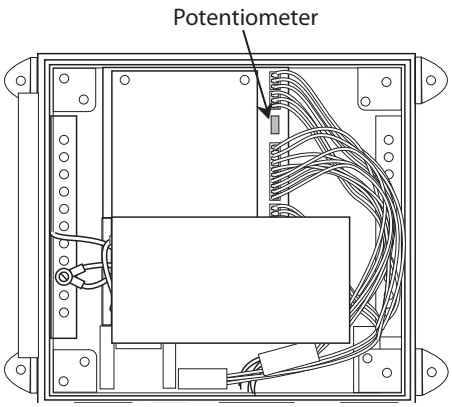


Figure 13 *Sensor Mirror Cleaning*

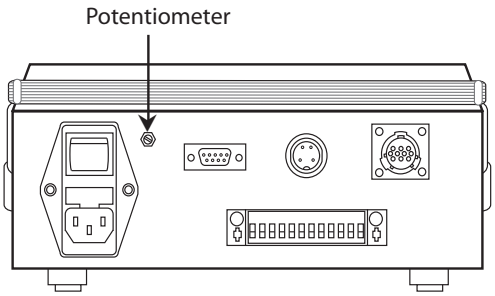
5.2 Resetting the Mirror Condition

This is an important part of the normal operation of the instrument. The mirror condition should be reset:

- after the mirror has been cleaned.
- after a significant change in sensor temperature.
- if the mirror condition shows **LOW** or flashing 0% on the display or application software during a DCC cycle.
- if the mirror condition is greater than 10% during a DCC cycle.



Optidew



Optidew Vision

Procedure (Optidew Series with display, or using application software)

NOTE: The instructions on the next page can be followed for adjustment using RS232/RS485 serial commands, if more convenient.

1. Clean the mirror according to the instructions above.
2. Cycle power to the instrument to initiate a DCC cycle.

   The instrument will now be in DCC for 4 minutes – it is important that the adjustments are only made in this mode. If the instrument comes out of DCC (the status LED will no longer be illuminated), just cycle power to the instrument.
3. Observe the mirror condition on the display, or the application software.
4. Adjust the potentiometer until the mirror condition is 0 - 2%.

   If the mirror condition shows **LOW** (on the display) or flashing 0% (on the application software) then it is under-range and a positive adjustment is required.

   NOTE: During adjustment there will be a delay of approximately 5 seconds before the mirror condition value updates to the actual value.
5. Cycle power to the instrument.

Procedure (using RS232/RS485 serial commands)

1. Connect to the instrument using the RS232/RS485 connection.
2. Send the following commands, one after the other:

Command	Description
st	Stops all continuous output to the serial port
gofth	Continuously outputs signal mirror level, between 0 and 1023
abc	Starts a DCC cycle

The instrument will now be in DCC for 4 minutes – it is important that the adjustments are only made in this mode. During this time adjust the potentiometer until the signal level is 150 ±10.

If the instrument comes out of DCC (the status LED will no longer be illuminated) send the **abc** command again.

3. Once adjustment is complete, cycle power to the instrument.

Appendix A

Technical Specifications

Appendix A Technical Specification

General			
Accuracy	**Dew Point:** ±0.2°Cdp (±0.36°Fdp) ±0.15°Cdp (±0.27°Fdp) accuracy optional **Temperature:** ±0.1°C (±0.18°F)		
Measurement Units	°C, °F dew point; %RH; °C, °F temperature; g/m^3; g/kg; a_w; Δ (t – t dew point)		
Response Speed	1°C per second (1.8°F per second) plus settling time (dew point dependant)		
Power Supply	90 to 264 V AC OR 127 to 370 V DC, 47 to 440 Hz, 20 W max Internally fused, 4A quick blow		
Sensor	**1-Stage**	**2-Stage**	**High Temperature PEEK**
Dew-Point Range	-30°Cdp at sensor temperature of 20°C to +90°Cdp at sensor temperature of 90°C	-40°Cdp at sensor temperature of 20°C to +90°Cdp at sensor temperature of 90°C	-40°Cdp at sensor temperature of 20°C to +130°Cdp at sensor temperature of 130°C
Temperature Range	-40 to +90°C (-40 to +194°F)	-40 to +90°C (-40 to +194°F)	-40 to +130°C (-40 to +266°F)
% RH Range	<2 to 100%	<0.5 to 100%	<0.5 to 100%
Min Measured Dew Point @ 20°C (68°F) ambient	-30°C (-22°F)	-40°C (-40°F)	-40°C (-40°F)
Mirror Material Options	Gold plated copper (standard) Gold stud 316 stainless steel stud* Platinum stud* *Recommended for special applications only, consult Michell Instruments before ordering		
Sensor Body Material Options	Acetal (standard) High temperature PEEK 316 stainless steel* Anodized aluminum* *Recommended for special applications only, consult Michell Instruments before ordering		
Temperature Measurement	4 wire Pt100, 1/3 DIN class B		
Sample Flow	0.1 to 2 Nl/min (0.2 to 4 scfh) (in sampling block)		
Maximum Velocity	10 m/sec (direct insertion) 30 m/sec (with sintered guard)		
Pressure	**Standard unit:** 2 Mpa / 20 barg (300 psig) (max) Ingress Protection: IP66 **High Pressure version:** 25 Mpa / 250 barg (3600 psig) (max) Ingress Protection: IP65		
Cable Length	2m (6.56ft); 50m (164ft) max (250m (820ft) on special request)		

Electronics	
Resolution	0.1 for °C, °F and %RH 0.01 for g/m^3 and g/kg
Outputs	**Analog**: 4-20 mA or 0-20 mA over user-settable output Accuracy: ±0.2°C (±3.6°F); 500 Ω maximum load resistance **Alarm**: Volt free contact, max 2 A @ 30 V DC, 0.5 A @ 120 V AC **Digital**: RS232 @ 9600 baud rate
Status LED's	**Optidew**: Power On, DCC/Alarm Status **Optidew Vision**: DCC/Alarm Status
Operating Temperature	-20 to +50°C (-4 to +122°F)
Environmental Conditions	Up to 98% RH non-condensing **Optidew (only)**: 100% RH condensing with optional weatherproof cable pack
Enclosure	**Optidew**: IP66 (NEMA 4) rated, 304 stainless steel (DIN 1.4301) **Optidew Vision**: IP54 (NEMA 2) rated, standing case with carry handle / Panel mounting kit optional
Cable Pack	Mains, RS232 cable and output connector

Appendix B

Optidew RS232 Commands

Appendix B Optidew RS232 Commands

Communications settings:
9600 Baud Rate, 8 Data Bits, No Parity, 1 Stop Bit, No Flow Control

Entering any of the 3 character commands followed by a <CR> will return the value of the parameter. i.e mmt<CR> will return the measurement time. Otherwise a new value can be set by entering mmt=X

General information:

- **view** shows system setup
- **ver** shows firmware version

Instrument functions:

- **abc** initiates an ABC cycle
- **maxon** drives the heat pump into max depression
- **maxoff** max depression off
- **faston** enables FAST function
- **fastoff** disables FAST function

- **cmdt** sets unit for CMDT mode (temperature measurement disabled)
- **opti** sets unit for OPTIDEW (temperature measurement enabled)

Measured and calculated parameters:

- **gdp** returns dew point value
- **gtp** returns temperature value
- **grh** returns %rh value
- **gofth** repeatedly outputs mirror signal level
- **gclm** returns clean mirror value

- **y** outputs status string **(refer to information on the following page)**
- **x** outputs status string continuously

- **st** stops any output to the serial port

Measurement settings:

- **degc** sets units to °C
- **degf** sets units to °F
- **prs=X** sets pressure value for compensation for gkg^{-1}, & gm^{-3}, where X is between 0 & 65535

- **abt=X** sets ABC duration, where X = integer between 0 & 65535
- **hdt=X** sets HOLD time, where X = integer between 0 & 65535
- **ht=X** sets max HOLD time, where X is between 0 & 65535
- **mmt=X** sets MEASUREMENT time, where X = integer between 0 & 65535

Current outputs:

- **opl=X** sets output1 minimum, where X = an integer between -200 & 200
- **oph=X** sets output1 maximum, where X = an integer between -200 & 200
- **outdp** sets current output1 to indicate DEWPOINT
- **outrh** sets current output1 to indicate %RH
- **outM3** sets current output1 to indicate gm^{-3}
- **outKG** sets current output1 to indicate gkg^{-1}
- **otl=X** sets output2 (temperature only) minimum, where X = an integer between -200 & 200
- **oth=X** sets output2 (temperature only) maximum, where X = an integer between -200 & 200

- **fourma** sets current outputs to 4 to 20mA
- **zeroma** sets current outputs to 0 to 20mA
- **out** returns current output setting

Alarm:

- **alv=X** sets alarm setpoint where X = -200 to +212
- **alp=X** sets alarm parameter 0=dp, 1=RH, 2=gm^{-3}, 3=gkg^{-1}, 4=Temp-DP, 5=Temp, 6=OFF

NOTE: Some commands may not feature in all versions of the firmware.

Optidew Status String

The measured values and status information can also be read as one string by entering the command **y<cr>**, which will output the information in the following format:

:**0207**0211**0975**0124**0589**2**11616**0897**2**0**1**<cr>

For continuous monitoring, send **x<cr>** which outputs the status string continuously as soon as it has been updated by the instrument. To stop this output send **st<cr>**.

The data string is fixed length of 35 characters and returns the following values:

- The first character '**:**' is the start character of the data string.
- Characters 2 to 5 represent the **dew-point value** multiplied by 10.

  In this example the value is **0207**, or 20.7°Cdp.

  NOTE: Negative values for dp are displayed using the following format:

  Dew point = (8000 – value) / 10

  e.g. 7999 = -0.1°C/F or 7793 = -20.7°C/F etc …
- Characters 6 to 9 represent the **ambient temperature value** multiplied by 10.

  In this example the value is 0211, or 21.1°C.

NOTE: Negative values for temperature are displayed using the following format:

Temperature = (8000 – value) / 10

e.g. 7999 = -0.1°C/F or 7789 = -21.1°C/F

- Characters 10 to 13 represent the **%RH value** multiplied by 10.

  In this example **0975** is equal to 97.5%RH.

- Characters 14 to 17 represent the **mirror signal level** and can have a value from 0 to 1023.

  In this example the value is 124, or 0%.

  NOTE: The mirror condition shown on the Optidew/Optidew Vision display and OptiSoft is rounded to a whole number and is calculated as follows:

  Mirror Condition % = (mirror signal level – 123) / 10

  e.g. (124-123)=1/10=0.1=0%

- Characters 18 to 21 represent the **depression of the heat pump** and can have a value from 0 to 1023.

  In this example the value is **0589**, or 24% (cooling).

  NOTE: The depression is shown on the Optidew/Optidew Vision display and OptiSoft as a percentage, and is calculated as follows:

  If depression > 450
  peltier drive % = (PeltierDrive - 450) / 5.73, **peltier is cooling**
  If depression < 450
  peltier drive % = (449 - PeltierDrive) / 4.49, **peltier is heating**
  If depression = 0 **peltier is neither heating nor cooling**

- Character 22 represents the **status of the instrument**.

  In this example the value is 2, or Measuring.

  0 = ABC, 1 = Data Hold, 2 = Measuring, 3 = Optics Alarm, 4 = Set-point Alarm.

- Characters 23 to 27 represent the **gm^{-3} value** to two decimal places, therefore **11616** = 116.16

- Characters 28 to 32 represent the **gkg^{-1} value** to two decimal places, therefore 08972 = 89.72

- Character 33 indicates if the **dew point / temperature values** are in °C or °F: 0 = °C, 1 = °F

  In this example it is **0**, or °C.

- Character 34 indicates if the instrument is cooling, heating, or is controlling: 0= cooling, 1= control, 2= heating.

  In this example it is 1, or control.

Appendix C

Troubleshooting Common Faults

Appendix C Troubleshooting - Common Faults

A list of common faults can be found in this section, along with associated diagnostic and troubleshooting actions.

- Cannot connect to HyperTerminal / OptiSoft
- Dew-point reading -100 or +473
- Dew-point reading shows fixed or ambient temperature
- Fixed 100% Mirror Condition
- Fixed flashing 0% (low) Mirror Condition
- Peltier power cooling 100%
- Temperature reading -100 or +473 or does not change
- Dew-point reading in error
- Dew-point reading unstable

The troubleshooting steps for each fault should be followed in the order that they appear.

WARNING:

Do not attempt to disassemble the instrument or sensor. This will invalidate the calibration and may cause permanent damage to the instrument, voiding the warranty.

It is permitted to remove the lid of the Optidew for the purpose of adjusting the mirror condition potentiometer only.

The Optidew Vision must NOT be disassembled.

Symptom: Cannot connect to HyperTerminal / Optisoft

Cause	**If unit has display it is not in REMOTE MODE**
Resolution	Enable REMOTE MODE by holding display button for approximately 7 seconds

Cause	**Unit is RS485 / RS422 communications version**
Diagnosis	Confirm unit is RS232 version
Resolution	To connect to a standard RS232 port on a PC an appropriate RS232 to RS422 or RS485 adaptor is required

Cause	**Serial ports have stopped responding on host PC**
Resolution	Restart Optidew and restart host PC / equipment

Symptom: Dew point reading -100 or +473

Cause	Sensor cable not connected or damaged
Diagnosis	Try another sensor cable
	Ensure continuity of sensor cable conductors i.e. Pin A – Pin A continuity
Resolution	Ensure sensor cable connections are sound
	Source replacement sensor cable from local Michell Instruments representative

Cause	Sensor PRT damaged – open or short circuit
Diagnosis	Try another sensor
	Measure resistance between sensor pins A & B. Should be ~108 Ω @ 21°C
Resolution	Contact Michell Instruments' Service department

Cause	Instrument hardware fault
Diagnosis	First try the troubleshooting steps listed above
Resolution	Contact Michell Instruments' Service department

Symptom: Dew-point reading shows ambient or fixed temperature

Cause	Sensor cable not connected or damaged
Diagnosis	Try another sensor cable
	Ensure continuity of sensor cable conductors i.e. Pin A – Pin A continuity
Resolution	Ensure sensor cable connections are sound
	Source replacement sensor cable from local Michell Instruments representative

Cause	Heating transistor on instrument damaged
Diagnosis	Run a DCC cycle, and run a MAXCOOL for a short period If temperature does not increase during DCC but does decrease during MAXCOOL then heating transistor on instrument damaged
Resolution	Contact Michell Instruments' Service department

Cause	Cooling transistor on instrument damaged
Diagnosis	Run a DCC cycle, and run a MAXCOOL for a short period If temperature increases during DCC but does not decrease during MAXCOOL then cooling transistor on instrument damaged
Resolution	Contact Michell Instruments' Service department

Cause	Heat pump damaged
Diagnosis	Try heating/cooling tests above
	Try a known working sensor with the instrument
	Check heat pump resistance between pins J and K on sensor connector, nominal 4 - 8 Ω
Resolution	Contact Michell Instruments' Service department

Cause	Instrument hardware fault
Resolution	Contact Michell Instruments' Service department

Symptom: Fixed 100% Mirror Condition (Constant heating)

Cause	**LED too dim (mirror condition not set correctly)**
Resolution	Set mirror condition during DCC cycle as per instruction in Section 5 (Maintenance) Ensure red sensor LED brightness changes as potentiometer is adjusted

	Sensor cable not connected or damaged
Diagnosis	Try another sensor cable
	Ensure continuity of sensor cable conductors i.e. Pin A – Pin A continuity
Resolution	Ensure sensor cable connections are sound
	Source replacement sensor cable from local Michell Instruments' representative

Cause	**No light detected (photo detector fault)**
Diagnosis	Ensure LED is illuminated while instrument is switched on
Resolution	Contact Michell Instruments' Service department

Symptom: Fixed 0% or flashing 0% (low) Mirror Condition (Constant cooling? See below.)

Cause	**LED too bright (mirror condition not set correctly)**
Resolution	Set mirror condition during DCC cycle as per instruction in Section 5 (Maintenance) Ensure red sensor LED brightness changes as potentiometer is adjusted

Cause	**Sensor cable not connected or damaged**
Diagnosis	Try another sensor cable
	Ensure continuity of sensor cable conductors i.e. Pin A – Pin A continuity.
Resolution	Ensure sensor cable connections are sound
	Source replacement sensor cable from local Michell Instruments' representative

Cause	**Photo detector fault**
Diagnosis	Block light from red sensor LED to mirror using cotton bud. Ensure mirror condition increases (to 100% or close)
Resolution	Contact Michell Instruments' Service department

Symptom: Peltier power cooling 100%

Cause	LED too bright (mirror condition not set correctly)
Resolution	Set mirror condition during DCC cycle as per instruction in Section 5 (Maintenance) Ensure red sensor LED brightness changes as potentiometer is adjusted

Cause	Sensor cable not connected or damaged
Diagnosis	Try another sensor cable
	Ensure continuity of sensor cable conductors i.e. Pin A – Pin A continuity
Resolution	Ensure sensor cable connections are sound
	Source replacement sensor cable from local Michell Instruments' representative

Cause	Dew point below measurement capability of sensor
Diagnosis	Check maximum depression from ambient temperature of 20°C meets criteria, by using the MAXCOOL function: Single Stage: 50-55°C Dual Stage: 60-65°C Metal Body (Aluminum, Stainless Steel): 40-45°C
Resolution	If the maximum depression does not meet specification, ensure the sensor is sufficiently ventilated to remove build-up of heat generated when the heat pump is cooling. High ambient temperatures will limit the depression range of the sensor. If the maximum depression is within the specification above, then the dew point may be below the measurement capabilities of the sensor. In this case contact Michell Instruments for further advice.

Cause	Photo detector fault
Diagnosis	Block light from red sensor LED to mirror using cotton bud. Ensure mirror condition increases (to 100% or close)
Resolution	Contact Michell Instruments' Service department

Symptom: Temperature reading -100 or +473, or does not change

Cause	Optidew set to CMDT mode
Resolution	Connect via RS232 / Hyperterminal, send the command: 'opti'

Cause	Remote PRT damaged
Diagnosis	Try another Remote PRT
	Check all resistances This is a 4 wire PRT: pins 1 and 3 should be short circuit; pins 2 and 4 should be short circuit The resistance between pins 1 and 2 or pins 3 and 4 should be ~108 Ω @ 21°C
Resolution	Source replacement PRT from Michell Instruments Ltd

Cause	Instrument hardware fault
Resolution	Contact Michell Instruments' Service department

Symptom: Dew-point reading in error

Cause	**If dew point < 0°C then error may be due to Optidew measuring super-cooled water on the mirror instead of ice. Error will be approximately 10% of reading**
Resolution	Refer to guide in appendices

Cause	**Internal PRT damaged or instrument electronics require calibration**
Resolution	If error > 0.5°C when checking against a reliable, recently calibrated reference, there is likely a problem with the instrument Return to service department for service and calibration

Symptom: Dew-point reading unstable

Cause	**Mirror is dirty**
Resolution	Clean mirror according to instructions in manual Set mirror condition during DCC cycle as per manual instructions

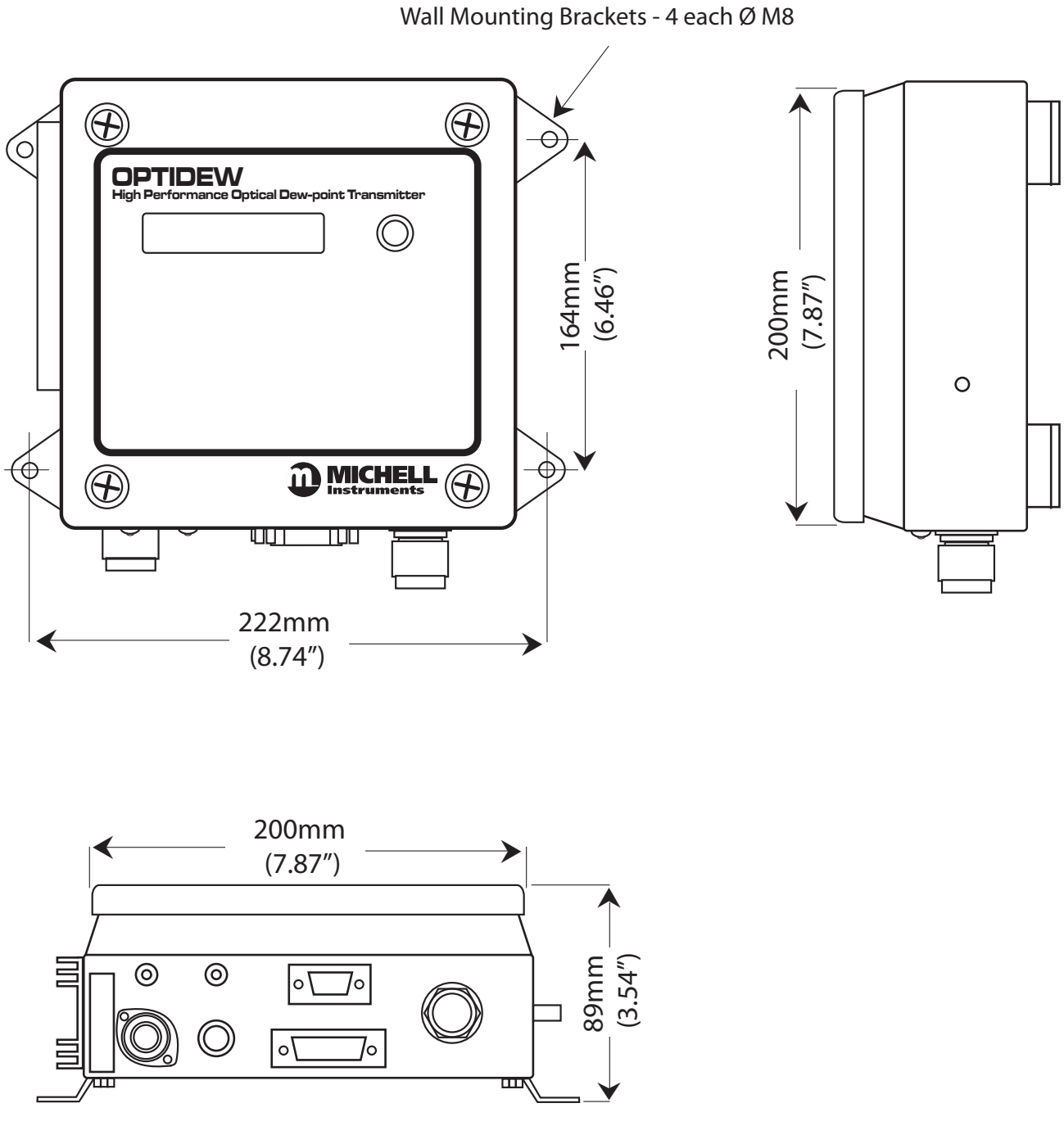
Cause	**Problem with measurement technique**
Resolution	Contact Michell Instruments. Provide the following information: • Flow rate • Temperature • Pressure • Gas composition • Expected dew point • Logged data (if available) • Description of application (e.g. measuring relative humidity in an environmental chamber)

Appendix D

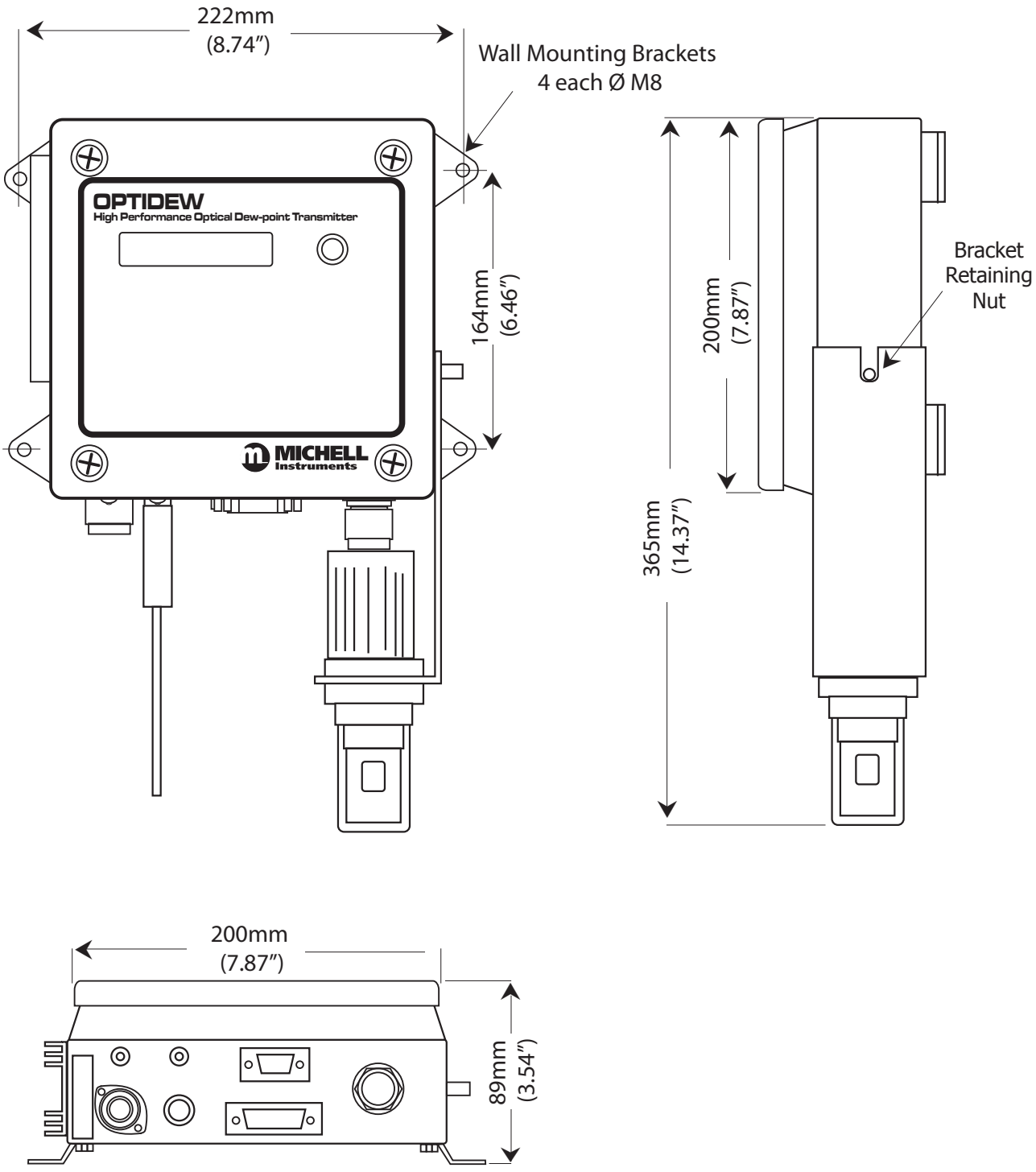
Dimensional Drawings

Appendix D Dimensional Drawings

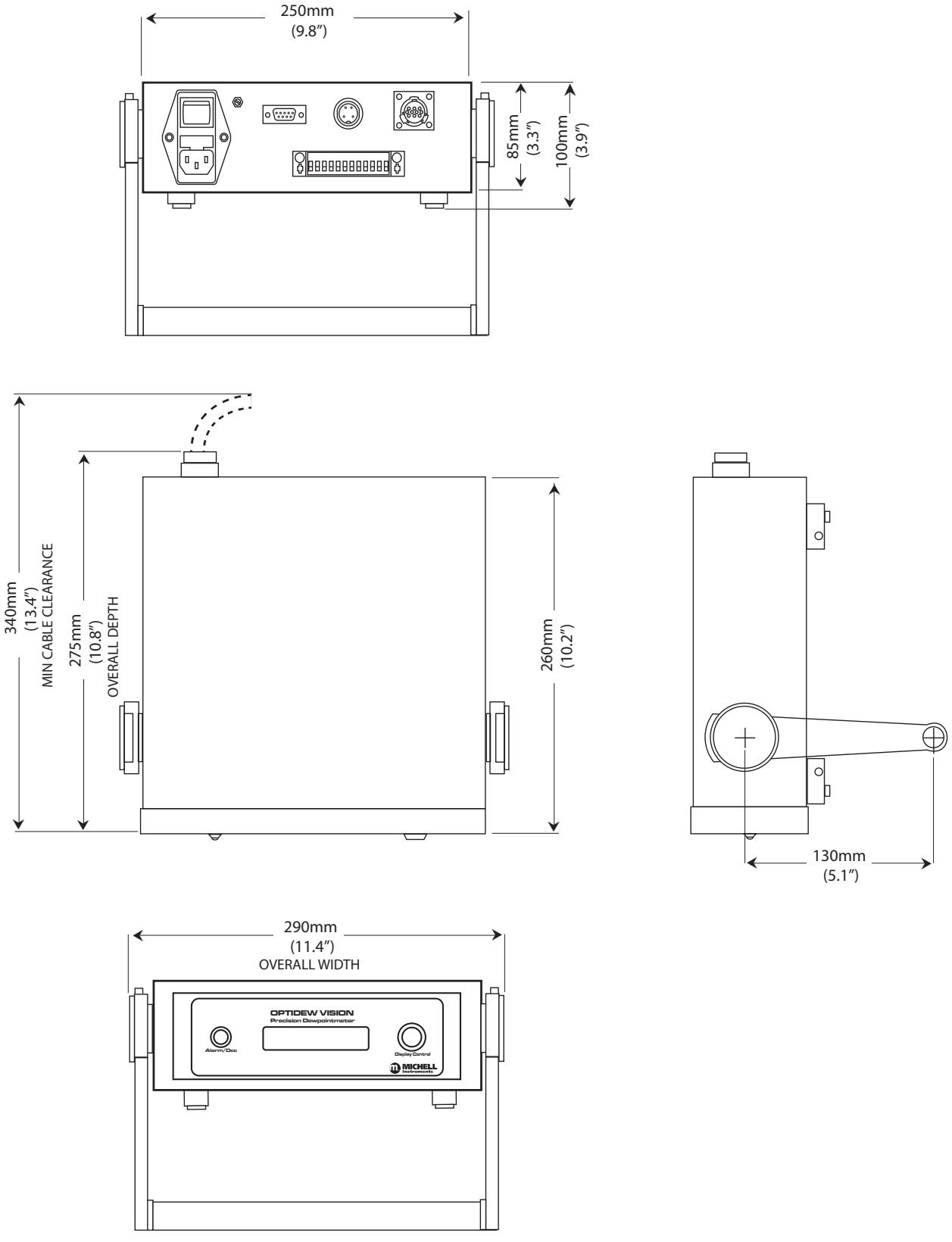
D.1 Optidew



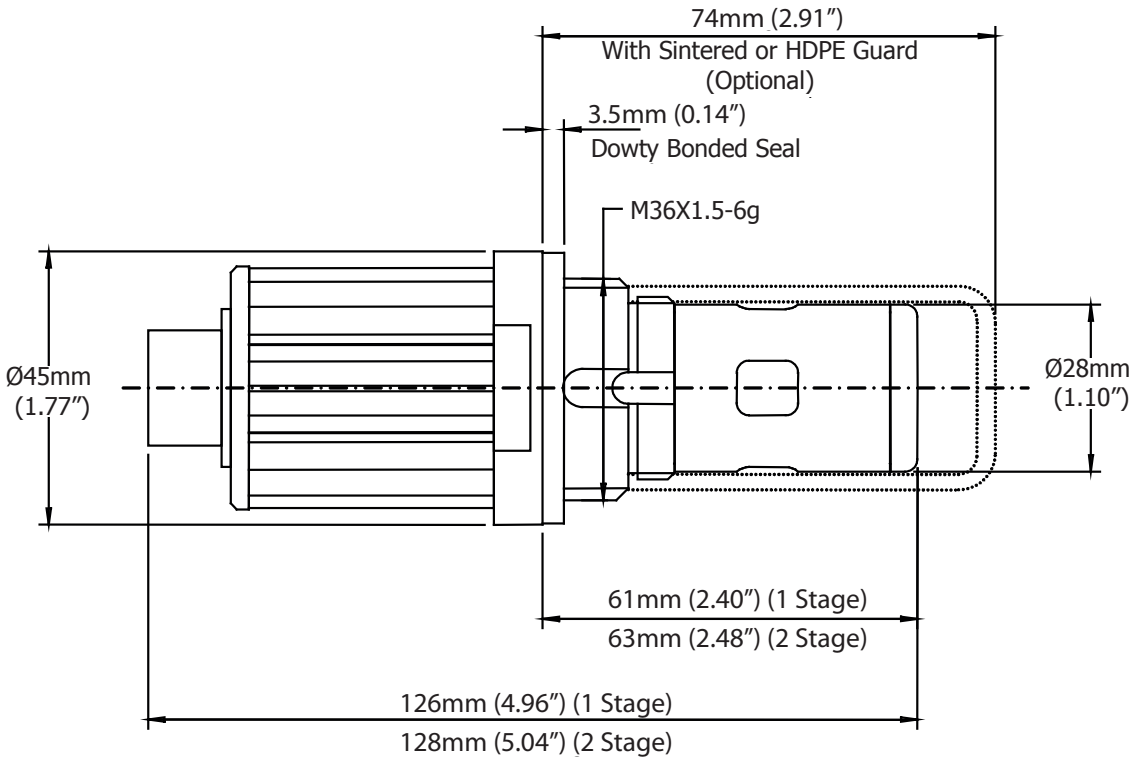
D.2 Optidew Integral Version



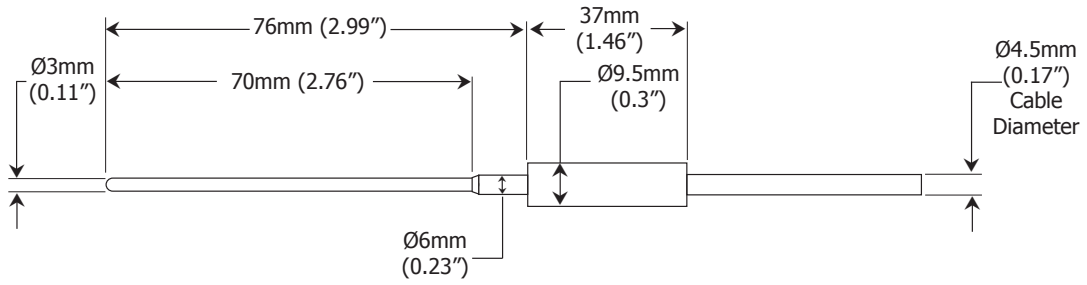
D.3 Optidew Vision



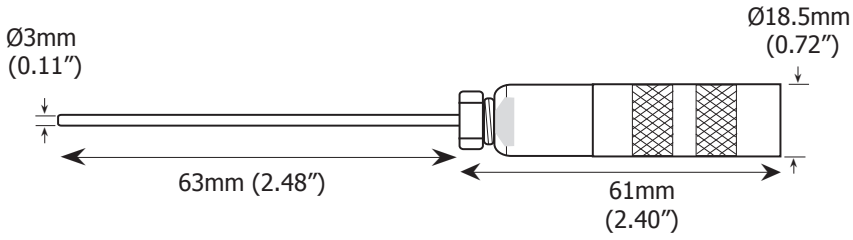
D.4 Sensor and Probe Dimensions



Sensor Overall Dimensions



Remote Temperature Probe Dimensions



Integral Remote Temperature Probe Dimensions

Appendix E

EC Declaration of Conformity

Appendix E EC Declaration of Conformity

E.1 Optidew

EC Declaration of Conformity

We, Michell Instruments Limited
48 Lancaster Way Business Park
Ely, Cambridgeshire
CB6 3NW. UK.

declare under our sole responsibility that the product

Optidew

to which this declaration relates is in conformity with the following standards or other normative document(s)

EN61326-1:2006	**Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements.**

following the provisions of

2004/108/EC	**EMC Directive**

Andrew M.V. Stokes, Technical Director

Date of Issue: 20 July 2009

E.2 Optidew Vision

EC Declaration of Conformity

We, Michell Instruments Limited
48 Lancaster Way Business Park
Ely, Cambridgeshire
CB6 3NW. UK.

declare under our sole responsibility that the product

Optidew Vision

to which this declaration relates is in conformity with the following standards or other normative document(s)

EN61326-1:2006	**Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements.**

following the provisions of

2004/108/EC	**EMC Directive**

Andrew M.V. Stokes, Technical Director

Date of Issue: 20 July 2009

Appendix F

Quality, Recycling & Warranty Information

Appendix F Quality, Recycling & Warranty Information

F.1 Pressure Equipment Directive (PED) 97/23/EC

The above Directive has been implemented in United Kingdom Law by the Pressure Equipment Regulations 1999.

The Regulations require that all pressure equipment and assemblies within the scope of the Pressure Equipment Directive must be safe when placed on the market or put into service.

Michell Instruments' products have been assessed and, as referenced against the Classification Charts detailed in Annex II of the Directive, do not fall into the requirements for CE marking compliance with the Pressure Equipment Directive.

Article 3, paragraph 3 states that any product containing a pressurized fluid that does not qualify for compliance should, nevertheless, be constructed with Sound Engineering Practice (SEP).

Michell Instruments attests here that its products have been designed, manufactured & tested to assure safe operation, and in accordance with Sound Engineering Practices.

F.2 Recycling Policy

Michell Instruments is concerned with the protection of the environment. It is our commitment to reduce and eliminate from our operations, wherever possible, the use of substances which may be harmful to the environment. Similarly, we are increasingly using recyclable and/or recycled material in our business and products wherever it is practical to do so.

To protect natural resources and to promote material reuse, please separate batteries from other types of waste and recycle responsibly. If batteries are not properly disposed of, these substances can cause harm to human health and the environment

The product that you have purchased may contain recyclable and/or recycled parts and we will be happy to provide you with information on these components if required. For further information please see the following sections.

F.3 WEEE Compliance

Directive 2012/19/EU 4 July 2012 on Waste Electronic and Electrical Equipment (WEEE)

The Waste Electronic and Electrical Equipment (WEEE) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

Michell Instruments is in full compliance with the WEEE Directive and is registered with an approved recycler (Registration No. WEE/JB0235YW) and treats the requirement of the directive and the protection of the environment with the utmost importance. All Michell Instruments' products are appropriately marked indicating their requirement for recycling.

It may be required to return certain instruments for treatment at the end of their working life.

Feb 2013

F.4 RoHS2 Compliance

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011

The Restriction of Hazardous Substances (RoHS) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

According to the EC Directive 2002/95/EC, Michell Instruments' products qualify as Category 9, Control and Monitoring Equipment. Under the 2002/95/EC Directive, Category 9 products are exempt from compliance with the Directive.

However, the careful design of all Michell Instruments' products takes into consideration the requirements of the Directive and, wherever possible, compliance is achieved. All future products will be developed entirely using compliant materials. Furthermore, Michell Instruments is taking active steps to remove non-compliant materials and components from existing products wherever these may occur. Presently, none of the non-compliant materials are known to occur in Michell Instruments' products.

The new Directive 2011/65/EU (RoHS2) entered into force on 21 July 2011 and required all Member States to transpose the provisions into their respective national laws by 2 January 2013.

Under the provisions of the RoHS2 EU Directive 2011/65/EU (Article 3, [24]) defines 'Control and Monitoring Equipment' specifically as 'monitoring and control instruments designed exclusively for industrial or professional use'.

RoHS2 EU Directive 2011/65/EU states the closing date for compliance of any Control and Monitoring Equipment product sold into the EU market place as 22nd July 2017.

However, the careful design policy of all Michell Instruments' products continues to attain compliance in the shortest practical timescales and strives to ensure that less than 0.1% of total mass per product, of all non-compliant materials, appear within them. Michell Instruments continues to monitor suppliers and material sources to ensure that compliance of goods provided is maintained.

January 2013

F.5 Warranty

Unless otherwise agreed, the Supplier warrants that, as from the date of delivery for a period of 12 months, the goods and all their component parts, where applicable, are free from any defects in design, workmanship, construction or materials.

The Supplier warrants that the services undertaken shall be performed using reasonable skill and care, and be of a quality conforming to generally accepted industry standards and practices.

Except as expressly stated, all warranties whether express or implied, by operation of law or otherwise, are hereby excluded in relation to the goods and services to be provided by the Supplier.

All warranty services are provided on a return to base basis. Any transportation costs for the return of a warranty claim shall reside with the Customer.

F.6 REACH Compliance

Regulation (EC) No. 1907/2006
Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Michell Instruments is a manufacturer of moisture measurement and gas analysis instrumentation and is a 'downstream' user of chemicals, as described by the EU Council Directive 76/769/EEC. The products we supply are not raw chemical products (goods).

Under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not contain or release any prohibited chemicals. No listed SVHC (Substances of Very High Concern) appear within products manufactured by Michell Instruments. Therefore the 0.1% mass per product, or total usage of 1 tonne/year, will never be exceeded. For these reasons we are neither required by obligation for registration nor for the creation of material safety data sheets (MSDS) for our products.

Our continued review of the SVHC Candidate List and latest additions is to ensure we remain compliant.

Michell Instruments maintains a hazardous material register in which MSDS data sheets are collated, and we will check that our suppliers will comply to REACH requirements for all materials and substances we use in the processes of our manufacturing.

In the unlikely event that any chemicals of concern appear in our products in quantities greater than 0.1% of total mass per product we will immediately inform you by correspondence according to the REACH Article 33 requirements. Our current appraisal is, however, that we do not expect or foresee such an incidence.

January 2013

F.7 Calibration Facilities

Michell Instruments' calibration facilities are among the most sophisticated in the world and have been recognized for their excellence.

Traceability to the National Physical Laboratory (NPL) UK is achieved through our UKAS Accreditation (Number 0179). This covers dew point over the range -90 to +90°C (-130 to +194°F) and also Relative Humidity.

Dew-point calibrations are also traceable to the National Institute for Standards & Technology (NIST) USA over the range -75 to +20°C (-103 to +68°F).

NOTE: Standard traceable calibration certificates for instruments and sensors are not issued under our UKAS accreditation. UKAS certificates are usually to special order and are clearly identified.

F.8 Return Policy

If a Michell Instruments' product malfunctions within the warranty period, the following procedure must be completed:

1. Notify a Michell Instruments' distributor, giving full details of the problem, the model variant and the serial number of the product.
2. If the nature of the problem indicates the need for factory service then the instrument should be returned to Michell Instruments, carriage prepaid, preferably in the original packaging, with a full description of the fault and the customer contact information.
3. Upon receipt, Michell Instruments will evaluate the product to determine the cause of the malfunction. Then, one of the following courses of action will be taken:
   - If the fault is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
   - If Michell Instruments determines that the fault is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs, at standard rates, will be provided. Upon receipt of the owner's approval to proceed, the product will be repaired and returned.

F.9 Manufacturing Quality

Michell Instruments is registered with the British Standards Institute for Quality Assurance to:

BS EN ISO 9001: 2008

Rigorous procedures are performed at every stage of production to ensure that the materials of construction, manufacturing, calibration and final test procedures meet the requirements laid down by our BSI approved Quality System.

Please contact Michell Instruments (www.michell.com) if the product does not arrive in perfect working order.

Appendix G

Return Document & Decontamination Declaration

Appendix G Return Document & Decontamination Declaration

Decontamination Certificate

IMPORTANT NOTE: Please complete this form prior to this instrument, or any components, leaving your site and being returned to us, or, where applicable, prior to any work being carried out by a Michell engineer at your site.

Instrument			Serial Number	
Warranty Repair?	YES	NO	Original PO #	
Company Name			Contact Name	
Address				
Telephone #			E-mail address	
Reason for Return /Description of Fault:				
Has this equipment been exposed (internally or externally) to any of the following? Please circle (YES/NO) as applicable and provide details below				
Biohazards	YES	NO		
Biological agents	YES	NO		
Hazardous chemicals	YES	NO		
Radioactive substances	YES	NO		
Other hazards	YES	NO		
Please provide details of any hazardous materials used with this equipment as indicated above (use continuation sheet if necessary)				
Your method of cleaning/decontamination				
Has the equipment been cleaned and decontaminated?	YES	NOT NECESSARY		
Michell Instruments will not accept instruments that have been exposed to toxins, radio-activity or bio-hazardous materials. For most applications involving solvents, acidic, basic, flammable or toxic gases a simple purge with dry gas (dew point <-30°C) over 24 hours should be sufficient to decontaminate the unit prior to return. **Work will not be carried out on any unit that does not have a completed decontamination declaration.**				
Decontamination Declaration				
I declare that the information above is true and complete to the best of my knowledge, and it is safe for Michell personnel to service or repair the returned instrument.				
Name (Print)		Position		
Signature		Date		

MICHELL Instruments

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